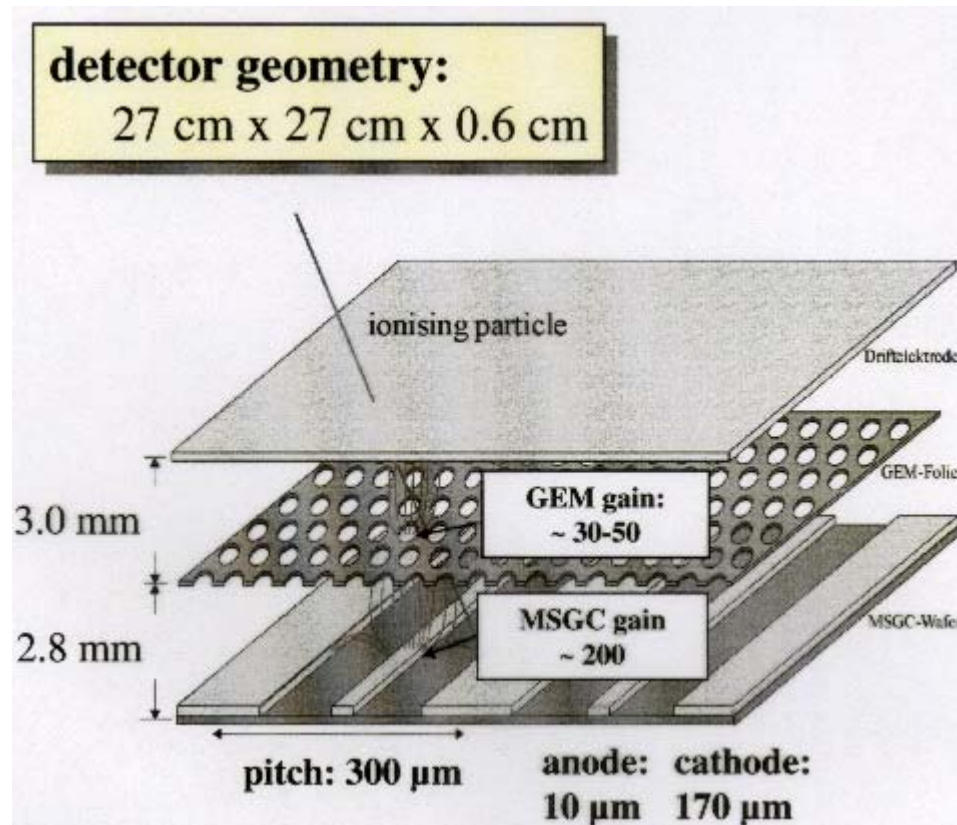


# Aging Experience with GEM- Detectors

## HERA-B MSGC with GEM



# HERA-B MSGC

Operation in hadronic beam:  
Spark problem due to HIP  
induced discharges  
→ fast destruction of strips  
HIP induced discharges are  
reproducible in Lab



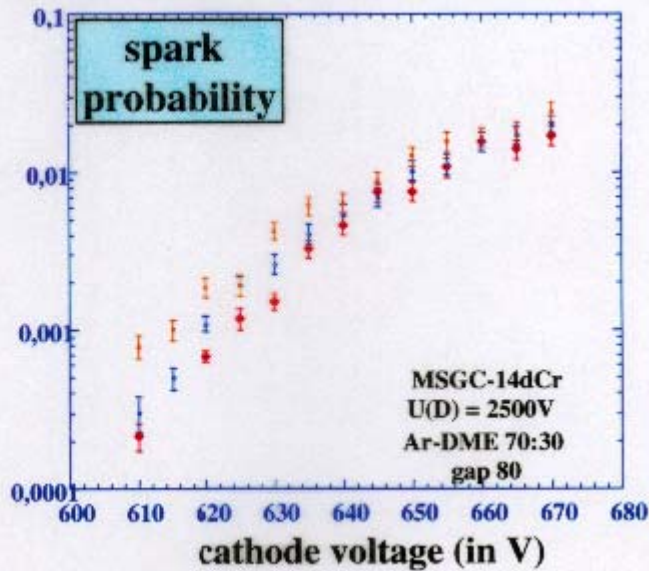
**Gold anodes and cathodes**



**Gold anodes and cathodes**

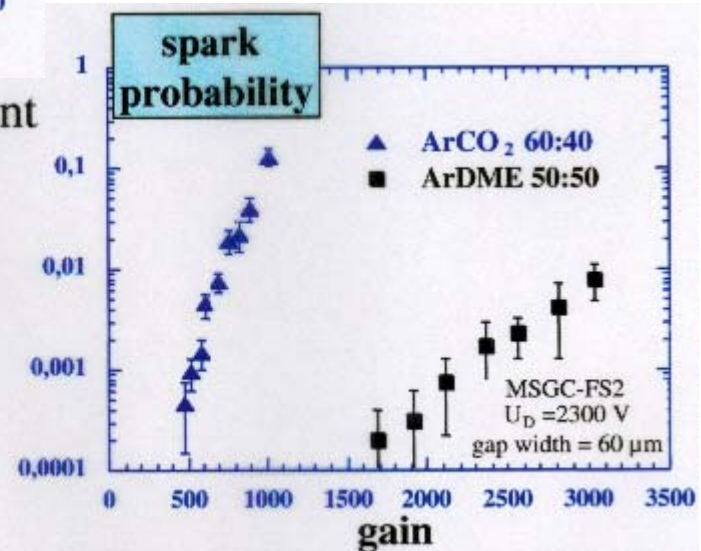
# HERA-B MSGC

- strong dependence on cathode voltage



- gas dependent

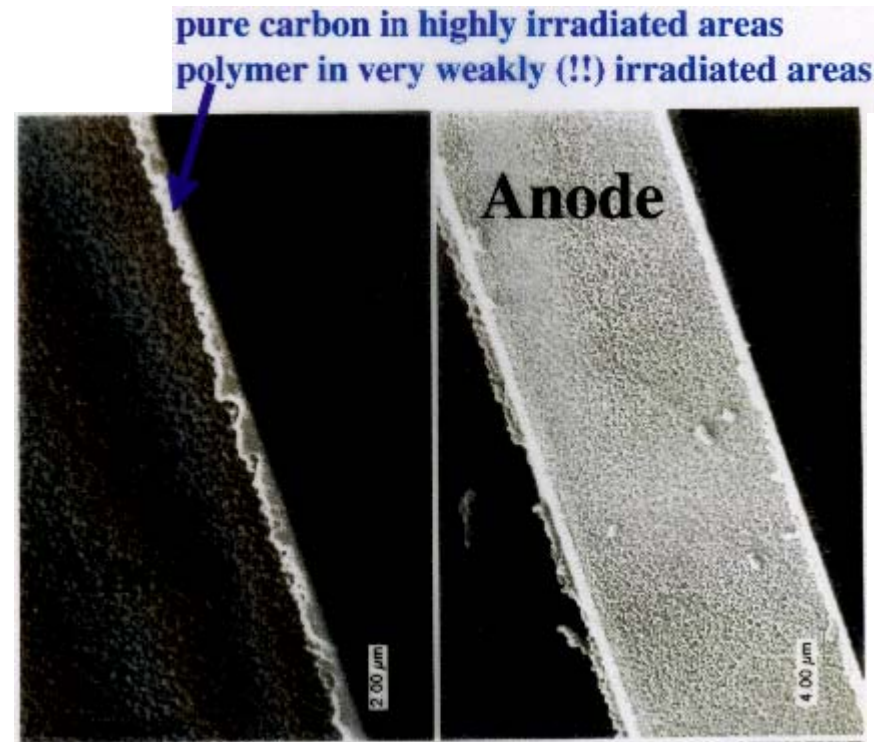
(ArDME much better than e.g. ArCO<sub>2</sub>)



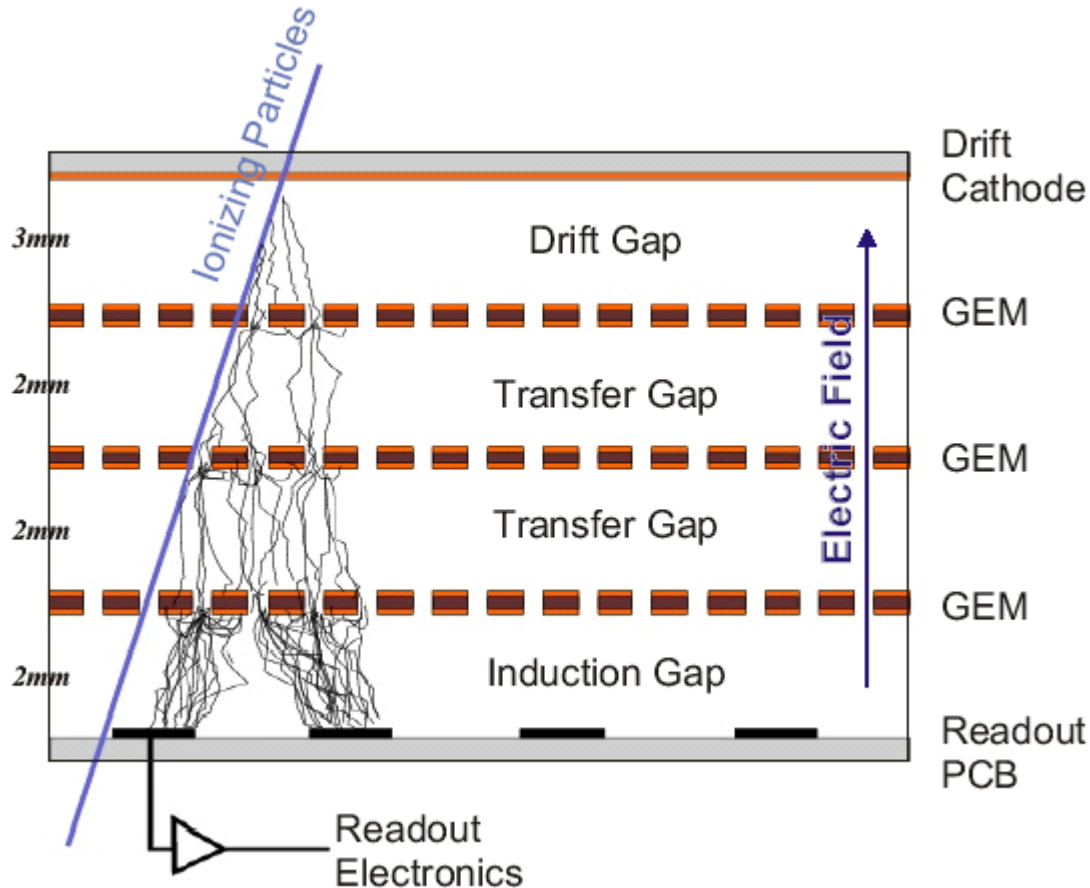
# HERA-B MSGC

Oct 1998, PSI test: (Ar-DME 50-50)

- rapid aging of chambers  
after 0.4 HERA-B years  
(2 mC/cm)
  - irradiation on large areas
  - conventional anode aging,  
deposits on anodes (and only there)
- 
- Similar destructions occurred when  
operated and irradiated fully at HERA
  - Elongation of GEM foil due to Ar/DME



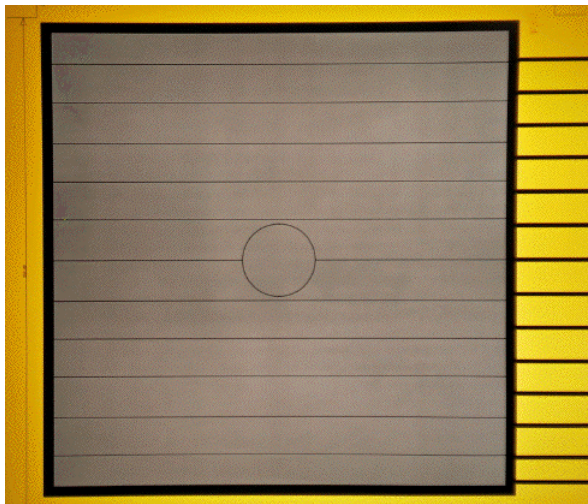
# COMPASS Triple GEM



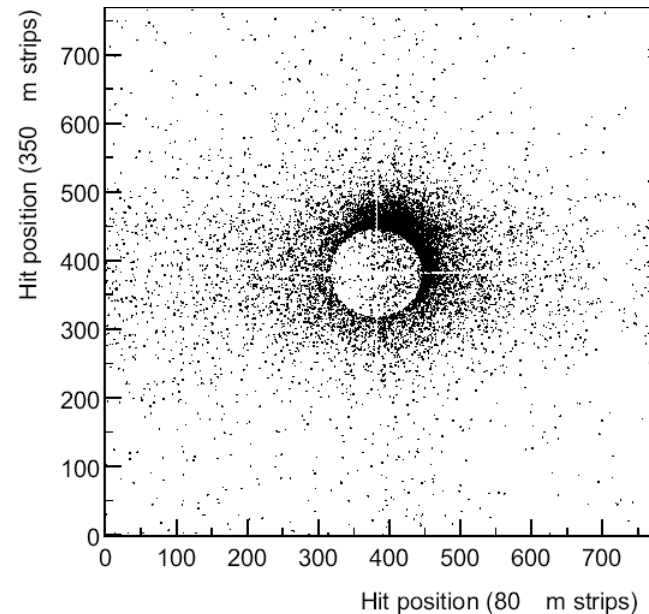
Readout at ground-potential

# COMPASS Triple GEM

COMPASS-beam:  $\sim 2 \times 10^8$  muons ( $\sim 10^8$  protons) per 5 s spill  
→ “beam killer”



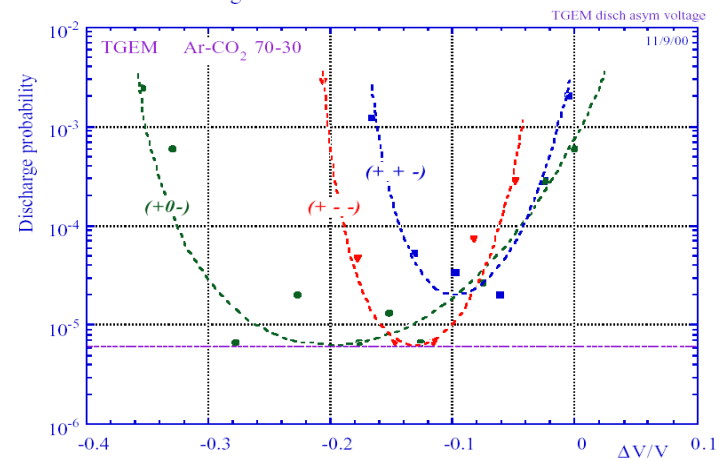
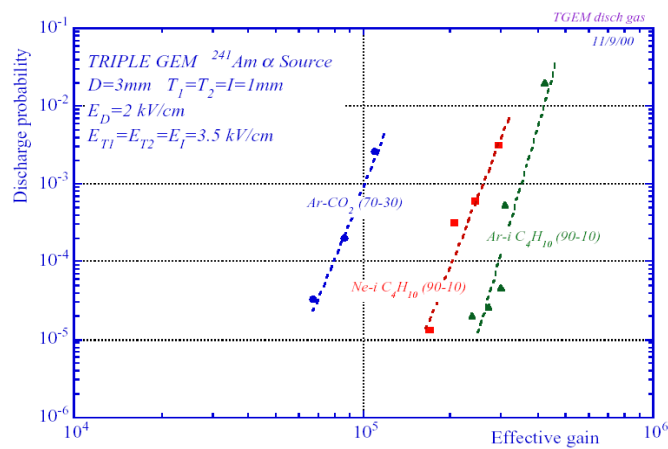
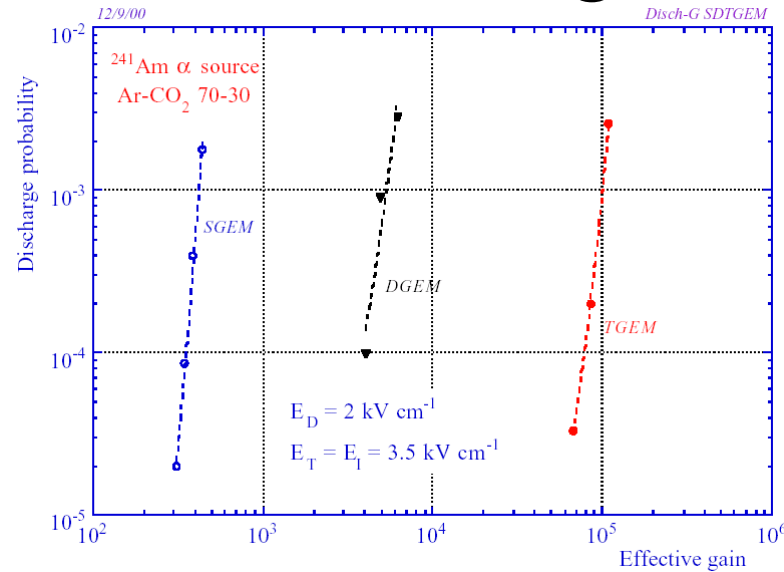
COMPASS-GEM foil



Hit map for  
 $\sim 2 \times 10^8$  muons/spill 6

# Triple GEM Discharge Probability

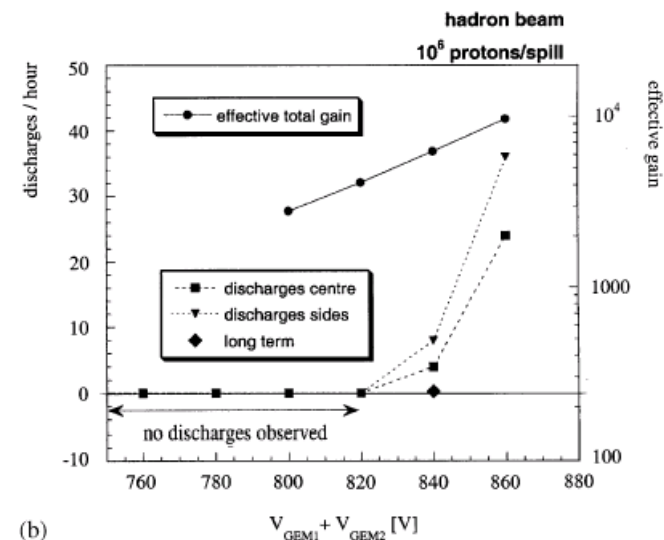
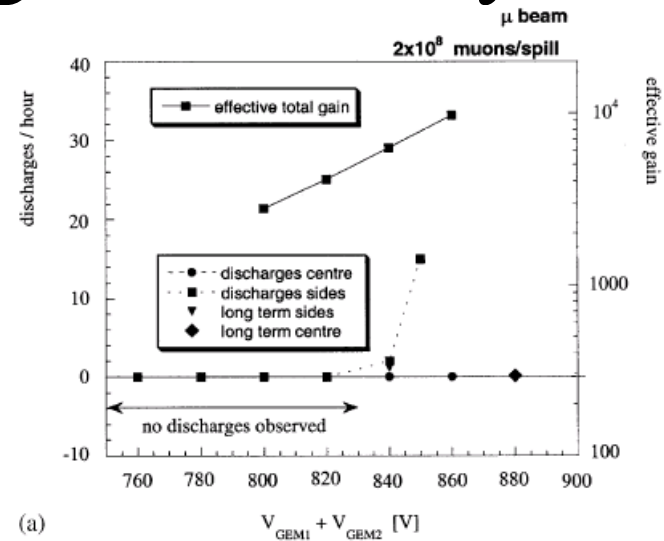
S. Bachmann et al.  
Nucl. Instrum. Methods  
A479(2002)294



# GEM Discharge Probability

Double GEM in M2 beam line:  
Discharges did not harm the  
detector

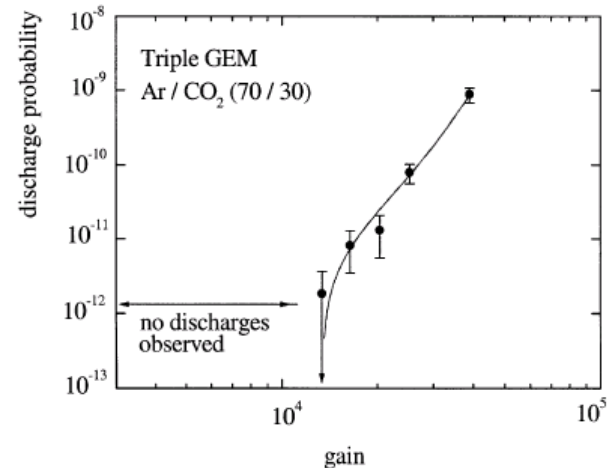
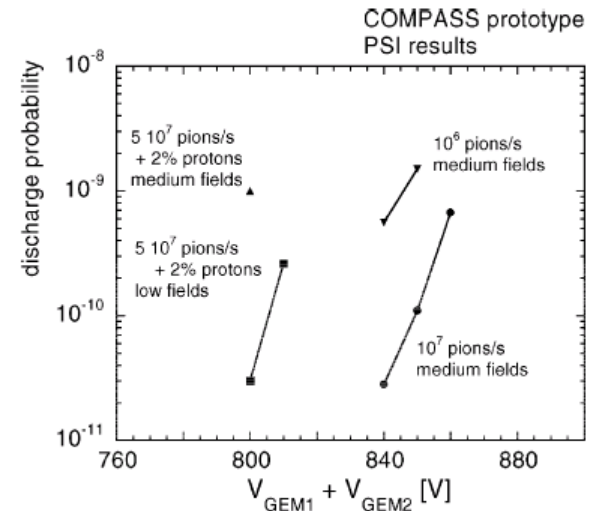
S. Bachmann et al.  
Nucl. Instrum. Methods  
A470(2001)548



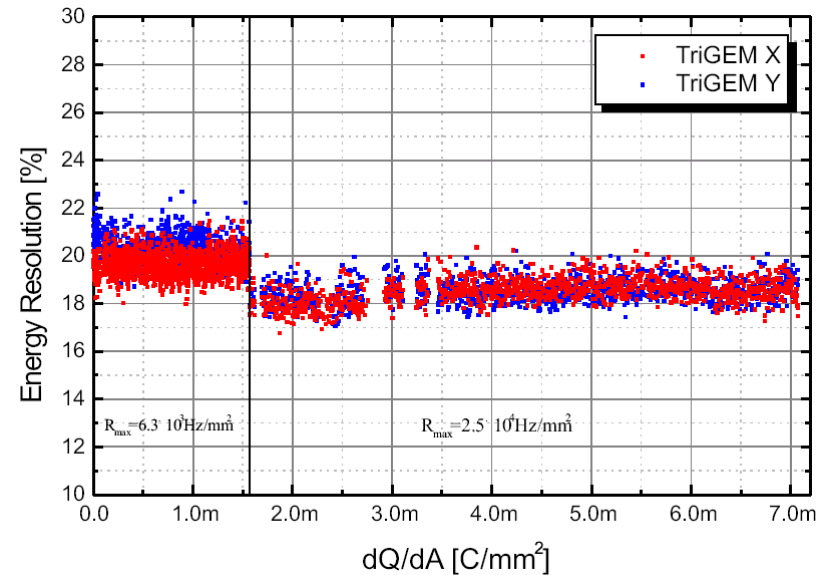
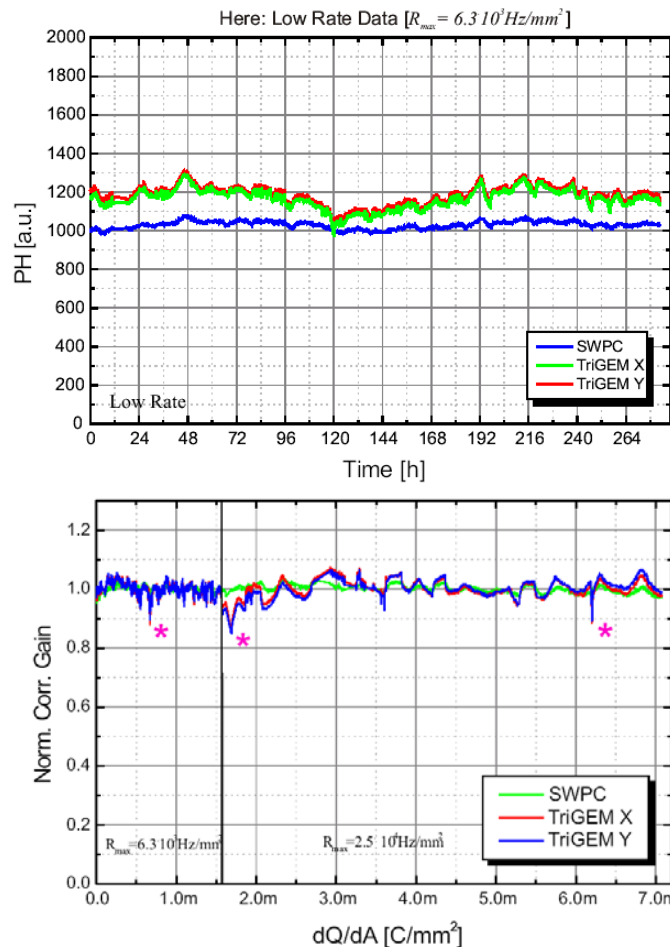
# GEM Discharge Probability

$\pi$ M1-beam at PSI:

- $5 \times 10^7$  pions/s
- after irradiation with  $10^{12} \pi$  at highest intensity no discharges observed
- Increasing the gain  $> 10^4$ : several thousand discharges  $\rightarrow$  fully operational until end of test beam



# Triple GEM Aging Test



\* = gas bottle exchanged

# Triple GEM Aging Test

+ Test of a large-size honeycomb triple-GEM detector ( $31 \times 31 \text{ cm}^2$ )

+ Production model with a less optimal choice of materials (epoxies, sealants, etc.)

+ Operated in Ar:CO<sub>2</sub> (70:30)

+ Effective gain of  $G_{\text{eff}} = 8500$

+ Aging Measurement performed with an  $8.9 \text{ keV}$  X-ray beam on  $\frac{1}{4}$  of the detector area in  $2 \times 10$  days

+ More than  $7 \text{ mC/mm}^2$  or  $1.7 \cdot 10^{11}$  MIPs/ $\text{mm}^2$  collected (corresponding to more than 5 yrs. COMPASS)

**No Loss of Gain or Energy Resolution observed!**

+ Gas mixture with good aging properties: Ar:CO<sub>2</sub>

+ Smaller sensitivity of the GEM to aging due to:

- Absence of thin anodes

- Gas amplification is localized inside the holes, rather far from signal electrodes and walls

- Field shape and strength only little affected by possible polymerisation deposits